PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Method for Deposition of Magnetic Film on Plastic Base

We, SPERRY RAND CORPORATION, a corporation organised under the laws of the State of Delaware, United States of America, of 315, Park Avenue South, New York 10, New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an improved magnetic information carrier having a thin film for the storage of information magnetically and to the production of such carrier. The film comprises or consists of cobalt and phosphorus and may contain in addition nickel.

Ferromagnetic films of cobalt and phosphorus or nickel, cobalt and phosphorus have been made before but their properties leave much to be desired in the way of greater uniformity and particularly the production of films which have a higher resolution. Resolution is usually defined as the ratio of output at a double frequency as opposed to the fundamental frequency. The nearer this ratio approaches unity, the greater the resolution.

The films produced are very thin and can perhaps more properly be considered as coatings, as a substrate is needed to impart the necessary mechanical strength. It is an object of the present invention to provide a magnetic information carrier using a flexible substrate of a plastic material and, deposited thereon, a thin film of cobalt and phosphorus or cobalt, phosphorus and nickel. The plastic may be polyglycol terephthalate sold under the name of Mylar (Registered Trade Mark). These flexible substrates present many advantages in practical use.

Magnetic information carriers in the past used largely oxide coatings and for a great many purposes, such as the recording of music, speech and the like, as well as for memory elements in computers and similar equipment. The carriers of the present invention can be produced to give resolutions 50% or even more than 50% higher than those which have been avaliable in the ordinary oxide coatings. The high resolution which is possible with the carriers of the present invention may be utilised in either or both of two directions. The higher the resolution the more clearly one bit of magnetic information is distinguished from another. This better discrimination between recorded bits of information also permits packing more bits in a given area and it is an advantage that with standard tape widths of ½" up to 2500 bits may be recorded per inch and recovered in clearly intelligible form. Of course, if the maximum of packing is not used the higher resolution can be utilised to produce a clearer output for a somewhat smaller number of bits. The particular compromise between maximum clarity and discrimination and maximum amount of information is one which is chosen in connection with the requirements of a particular tape, but it is an advantage of the present invention that the increased resolution is always advantageous and permits a wide range of compromise uses which adds a desirable flexibility to the tapes of the present invention.

There is provided by the present invention a magnetic information carrier comprising a flexible substrate of a plastic material and a thin film coating the substrate, containing cobalt and phosphorus and optionally nickel and deposited on said substrate by electroless plating; the thin film having a content of 1—7% by weight of phosphorus, 40—99% by weight of cobalt and 0—59% by weight of nickel. The composition limits of the present invention are shown in the drawing which represents a three phase diagram, and which designates the area within which useful coat-

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Price 75p

ings can be obtained. On the diagram there is shown both the area of maximum phosphorus variation and a somewhat smaller area between 2 and 5% of phosphorus which is preferred for coatings of maximum quality. The larger area which corresponds to the broader aspect of the present invention is defined by solid lines, and the smaller preferred area by dashed lines.

The outer, solid line, diagram has the following limits:

P	1%	7%	7%	1%
Ni	0%	0%	53%	59%
Co	99%	93%	40%	40%

The inner, dotted line, diagram has the following limits:

P	2%	5%	5%	2%
Ni	0%	0%	25%	28%
Co	98%	95%	70%	70%

In a further aspect of the invention a process is provided for making the carriers of the invention wherein the surface of said substrate is cleaned in a hot aqueous alkaline bath, a surface thereof sensitised in an aqueous bath of a sensitiser, preferably a salt of tin or titanium, the sensitised surface of the substrate seeded with a dilute aqeous solution of a soluble salt of a noble metal, and the so prepared surface of the substrate plated with an aqueous bath containing a major portion of a soluble cobalt compound and from 11 to 13 g/l of a hypophosphite ion. The process includes features which have been used with other processes in combination with the new features of the present invention. One of these features which is necesary but not new by itself except in combination with the other features of the invention is the sensitising of the substrate on which the coating is to be deposited. This is necessary, as with many substrates, for example plastic tapes, electroless deposition of coatings is not effective to produce uniform, strongly adherent coatings unless the surface is first sensitised. The process of the present invention has the same requirement. Any of the known sensitisers may be used. A few illustrative examples of typical sensitizers are soluble salts of elements such as tin and titanium. Because of their ready avaliability the chlorides are most frequently used.

The sensitised substrate must then be subjected to a procedure which is known in the art as "seeding". This is effected by applying a dilute solution of a salt of a noble metal such as a metal of the platinum group, gold, etc. It should be noted that the net effect of the sensitization and seeding procedure is to precipitate small amounts of reduced noble metals which appear to have a catalytic action in the deposition of the final coating.

An important feature of the process aspect of the present invention is the use of a hypophosphite in the formation of the coating in quite definite amounts. In order to produce optimum coatings by the improved process of the present invention the hypophosphite ion which is present in the coating bath should be held between 11 and 13 grams per liter of bath. The concentrations of nickel and cobalt salts in the bath are less critical, but of course they must be used in amounts to produce a final coating in which the cobalt or nickel and cobalt falls within the range specified in the three phase diagram of the drawings referred to above.

The invention will also be described in greater detail in conjunction with the specific examples in which the proportions are by weight unless otherwise specified.

Example 1

The substrate is 1/"2 Mylar tape, 1 mil in thickness. The tape is first cleaned of oily or other deposits by heating in an alkaline solution of 16 ounce/gal. sodium hydroxide, the temperature is maintained at 170 to 180° F. Contact time is not critical, but good cleaning can be effected with about 1 to 5 minutes contact with each portion of the tape. The tape can advantageously be slowly moved through the heated bath. The alkaline solution is carefully rinsed off with cold water. The cleaned tape is then subjected to sensitization by passing it through a bath containing 10 gm/l stannous chloride and 40 cc/l of strong hydrochloric acid. The contact time of the tape with the sensitizing bath should be a minute or somewhat longer. The temperature is not critical and the sensitization is therefore effected at ordinary room temperature. The stannous chloride is absorbed by the plastic and so when the tape is rinsed with cold water it remains in contact therewith.

The sensitized tape is then passed at room temperature through a seeding bath which is an aqueous solution containing 1 gm/l palladium chloride and 10 cc/l strong hydrochloric acid. Treatment time is the same as for sensitization, that is to say a minute or more, and the seeded tape is then again rinsed with cold water. After seeding the tape has a small amount of reduced palladium in its surface.

Deposition of the coating now follows. The seeded tape is coated by contacting at 170° to 180° F with an aqueous bath having the following composition:

$CoCl_2$—$6H_2O$	60 gm/l
$NiCl_2$—$6H_2O$	2 gm/l
Rochelle Salt	200 gm/l
NH_4Cl	50 gm/l
NaH_2PO_2—H_2O	20 gm/l
PH	8.0 to 10.5 (electrometric)

The time of contact with the bath will vary depending on the thickness of the coating desired. A good coating can usually be obtained with a treatment time of approximately three minutes. The resulting coating is composed of approximately 90% cobalt 7% nickel and

3% phosphorus. The cobalt and nickel percentages may vary slightly from batch to batch.

Testing the coating produced above against the standard oxide coating gave a 60% resolution when tested at 600 pulses per inch over 300, whereas a corresponding standard oxide film showed a resolution of only 40%.

EXAMPLE 2

The procedure of Example 1 was repeated, but instead of stannous chloride the same amount of titanium chloride was used, and the palladium chloride was replaced with chloroplatinic acid. In the coating bath itselif the cobalt was reduced to 35 gm/l and the nickel chloride increased from 2 to 25 gm/l, the other chemicals remaining as in Example 1. A film was produced having approximately 40% cobalt, 56% nickel and 4% phosphorus. The coating gave good results but the resolution was somewhat lower than in the case of Example 1.

WHAT WE CLAIM IS:—

1. Magnetic information carrier comprising a flexible substrate of a plastic material and a thin film coating the substrate, containing cobalt and phosphorus and optionally nickel and deposited on said substrate by electroless plating; the thin film having a content of 1—7% by weight of phosphorus, 40—99% by weight of cobalt and 0—59% by weight of nickel.

2. Information carrier according to claim 1, in which the thin film has a content of 2—5% by weight of phosphorus, 70—98% by weight of cobalt and 0—28% by weight of nickel.

3. Information carrier according to claim 1 or 2, characterised in that said substrate of plastic material is in the form of a plastic tape.

4. Process for the manufacture of the magnetic information carrier according to claim 1, wherein the surface of said substrate is cleaned in a hot aqueous alkaline bath, a surface thereof sensitised in an aqueous bath of a sensitiser, the sensitised surface of the substrate seeded with a dilute aqueous solution of a soluble salt of a noble metal, and the so prepared surface of the substrate plated with an aqueous bath containing a major portion of a soluble cobalt compound and from 11 to 13 g/l of a hypophosphate ion.

5. A process according to claim 4 wherein the sensitizer is a salt of tin or titanium.

6. The magnetic information carrier substantially as hereinbefore described with reference to either Example 1 or Example 2.

7. The process for the manufacture of a magnetic information carrier substantially as hereinbefore described with reference to either Example 1 or Example 2.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*